COST AND PERFORMANCE REPORT

Soil Vapor Extraction
at Fort Richardson Building 908 South

July 1998

Prepared by:
U.S. Army Corps of Engineers
Hazardous, Toxic, Radioactive Waste
Center of Expertise

SITE INFORMATION

IDENTIFYING INFORMATION

Site Name: Fort Richardson, Building 908 South (Ft. Richardson)
Location: Anchorage, Alaska
Technology: Soil Vapor Extraction (SVE)
Type of Action: Indefinite Delivery Type Remedial Action (IDTRA)

TECHNOLOGY APPLICATION (7, 8)

Period of Operation: February 1995 - ongoing (closure planned for Spring of 1999)
Quantity of Material Treated During Application: Estimated as 4,600 cubic yards of soil

BACKGROUND

SIC Code: 9711 (National Security)

Waste Management Practice that Contributed to Contamination: Leaking underground storage tank

Site Background (4,5):

- Ft. Richardson, constructed in 1950, is located adjacent to Elmendorf Air Force Base (AFB) and is eight miles from Anchorage, Alaska.
- At Ft. Richardson, four underground storage tanks (UST) were removed in 1989 and 1990. Those tanks included a 1,000-gallon unregulated heating oil tank (Tank No. 82) that was removed in September 1989 from an area adjacent to Building 908 South. Building 908 is referred to as the 1117th Signal Battalion Stockroom and is in an industrial area at Ft. Richardson. A railroad spur runs next to the building.
- Excavation of soil was to proceed until the site was free of contamination; however, no clean reading was obtained after the affected soil had been removed. The Alaska Department of Environmental Conservation (ADEC) allowed backfilling of the site, with the understanding that the Ft. Richardson Directorate of Public Works (DPW) would remediate the site at a later time.
- The excavation at Building 908 South was completed to a depth of 26 feet and was backfilled with clean soil.

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- At the time the excavation was performed, soil contaminated with petroleum products, primarily diesel range organics (DRO), were identified under the excavation; those soils were identified for remediation at a later date.
- At a meeting on June 13, 1990 attended by ADEC, DPW, and the U.S. Army Corps of Engineers (USACE) Alaska District, the representatives of ADEC recommended that further site characterization be conducted before proceeding with remediation activities. In August and September 1990, USACE performed the additional characterization activities, including collection of soil borings.
- This report is limited to a discussion of activities at Building 908 South at Ft. Richardson.

Remedy Selection (4, 7):

- Several remedies were considered for treating the petroleum-contaminated soil at Ft. Richardson, including low-impact bioventing, aggressive bioventing, natural attenuation with installation of a protective cap, and natural attenuation (natural attenuation was identified as the "baseline" alternative). Low-impact bioventing was selected for this application. The factors that supported the decision to use low-impact bioventing included project cost, duration of treatment, anticipated capability to meet cleanup goals, monitoring requirements, and management factors (such as the use of interagency agreements and considerations related to public acceptability).
- In the selection process, low-impact bioventing scored the highest of the four options, with a final score of 1.2. Natural attenuation scored 0, natural attenuation with a protective cap scored 0.78, and aggressive bioventing scored 0.88. The relatively high score for low-impact bioventing was in part a result of the relatively high score for management assigned to that option.
- Although low-impact bioventing was initially selected for this application, SVE was the remedy used. The SVE system did not require the nutrient injection or monitoring of biological activity parameters that would have been needed for bioventing.

SITE LOGISTICS/CONTACTS

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Remediation Contractors (5, 6):

Linder Construction served as prime contractor to USACE for this application and was responsible for installation of the treatment system and for mechanical operations of the monitoring system. AGRA Earth & Environmental (AEE), a subcontractor to Linder, was responsible for the monitoring of system effectiveness and for preparation of a conceptual design report and an interim remedial action report.

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MATRIX AND CONTAMINANT DESCRIPTION

MATRIX IDENTIFICATION

Soil (in situ)

CONTAMINANT CHARACTERIZATION

Semivolatiles (Nonhalogenated):	DROs
Volatiles (Nonhalogenated):	Gasoline range organics (GRO), benzene, toluene, ethylbenzene, and xylenes (BTEX)
Volatiles (Halogenated):	Chlorobenzenes

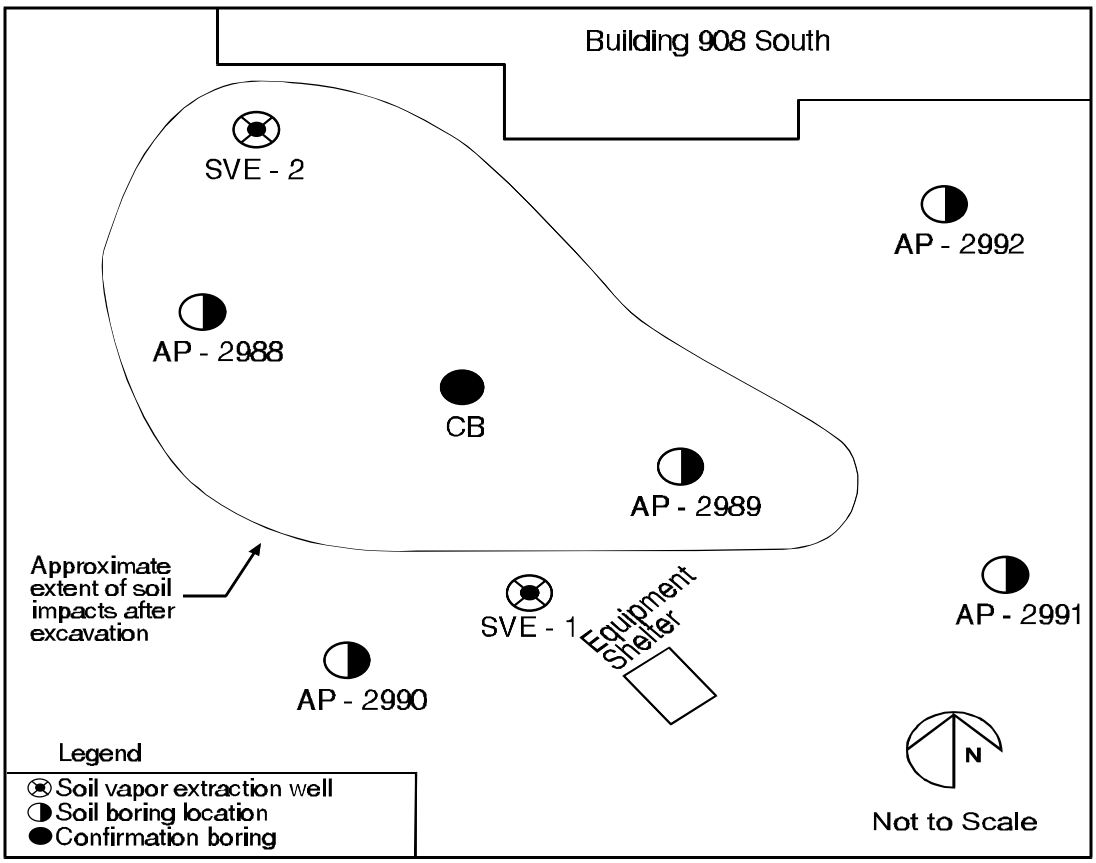
CONTAMINANT PROPERTIES

- The terms DRO and GRO are indicator parameters that refer to a range of hydrocarbons and are defined by ADEC as follows:
  - DRO - hydrocarbons in the range of C_{10} - C_{28}
  - GRO - hydrocarbons in the range of C_6 - C_{10}

- Provided below are the properties of BTEX and chlorobenzene.

Property	Benzene	Toluene	Ethyl-benzene	Xylenes	Chloro-benzene
Chemical Formula	C_6H_6	$C_6H_5CH_3$	$C_6H_5C_2H_5$	$C_6H_{4}(CH_3)_2$	C_6H_5Cl
Molecular Weight	78.11	92.14	106.17	106.17	112.5
Specific Gravity (at 20° C)	0.88	0.87	0.87	0.86 - 0.88	1.105
Vapor Pressure (mm Hg at 70° F)	79.4	23.2	10.4	5.2 - 9	10.1
Boiling Point (°C at 760 mmHg)	80.1	110.6	136.2	138.3 - 144.4	131.6
Octanol-Water Partition Coefficient (K_{ow})	132	537	1,100	1,830	692

Figure 1. Location of Soil Borings and Extraction Wells (6)



CONTAINMENT CONCENTRATIONS (4)

- In September 1989, at the time of the excavation, five soil borings were completed in the vicinity of Building 908 South. Figure 1 shows the locations of these borings. Soil samples were collected from the borings at depths ranging from 5 to more than 50 feet below ground surface (bgs) and analyzed for kerosene K-1, diesel fuel #2, jet fuel A, bunker fuel #6D, BTEX, and chlorobenzenes. Table SB-1 shows results of analysis of the soil samples. (Kerosene, diesel fuel, jet fuel, and bunker fuel include constituents identified as DROs.)

- As Table SB-1 shows, concentrations of diesel fuel #2 as high as 17,000 milligrams per kilogram (mg/kg) were detected (Bore Hole AP-2989; sample depth 5 to 6.5 feet). Five soil samples contained diesel fuel #2 concentrations higher than 200 mg/kg. In addition, Table SB-1 shows concentrations of kerosene as high as 18 mg/kg, concentrations of jet fuel as high as 1,200 mg/kg, and concentrations of bunker fuel as high as 94 mg/kg.

- Table SB-1 also shows concentrations of benzene detected as high as 0.11 mg/kg, toluene as high as 7.1 mg/kg, chlorobenzene as high as 6.7 mg/kg, m-dichlorobenzene as high as 11.0 mg/kg, and o-, p-dichlorobenzene as high as 91.0 mg/kg.

MATRIX CHARACTERISTICS AFFECTING TREATMENT COST OR PERFORMANCE, [4]

Listed below are the major matrix characteristics affecting cost or performance for this technology and the values measured for each parameter.

Parameter	Value
Soil Classification	See Table ST-1
Clay Content and/or Particle Size Distribution	Information not available
Moisture Content	Information not available
Air Permeability	Information not available
Porosity	Information not available
Total Organic Carbon	Information not available
Nonaqueous Phase Liquids	Not identified
Contaminant Sorption	Information not available
Lower Explosive Limit	Information not available
Presence of Inclusions	Information not available
Humic Content	Information not available

Table SB-1. Results of Analysis of Soil Borings Collected in September 1989* (4)

Bore Hole Number	AP-2988	AP-2988	AP-2988	AP-2988	AP-2988	AP-2989	AP-2989	AP-2989	AP-2989	AP-2989	AP-2989	AP-2990	AP-2990	AP-2990
Sample ID (90FRUST-)	123	126	127	130	131	132	133SL QC	133SL QA	137	138	139	143	144SL QC	145SL QA
Sample Depth (ft)	20-21.5	35-36.5	40-41.5	45-46.5	>50	5-6.5	5-6.5	5-6.5	25-26.5	30-30.5	35-36.5	5-6.5	5-6.5	5-6.5
Petroleum Hydrocarbons (EPA Method 8015M) (mg/kg)														
Kerosene K-1	<2.4	<180	<19	18	<1.9	<89	NR	NR	<190	<18	<18	<1.8	NR	NR
Diesel fuel #2	17	<180	<19	1900**	160**	5300**	8300	17000	1800**	370**	43**	<1.8	NR	310
Jet Fuel A	<2.4	1200	460	<18	<1.9	<89	NR	NR	<190	<18	<18	74**	56	NR
Bunker Fuel #6D	<12	<920	94	<92	<97	<450	NR	NR	<930	<91	<91	<8.9	NR	NR
Volatile Organics (EPA Method 8020) (mg/kg)														
Benzene	<0.14	<0.54	<0.56	<0.05	<0.47	<0.63	NR	NR	0.11	<0.05	<0.01	<0.01	NR	NR
Toluene	<0.14	<0.54	4.1	<0.05	2.1	2.1	7.1	0.016	0.39	<0.05	<0.01	<0.01	NR	0.012
Chlorobenzene	<0.14	1.4	6.7	0.22	1.1	2.7	6.5	NR	0.529	0.045	<0.01	<0.01	NR	NR
Ethylbenzene	<0.14	<0.54	<0.56	<0.05	<0.57	0.75	2.4	0.23	0.12	<0.05	<0.01	<0.01	NR	0.008
m-Xylene	0.38	4.3	10.0	0.72	1.8	11.0	70.0	0.215	1.4	0.1	0.046	<0.01	NR	0.06
o-, p-Xylene	<0.14	<0.54	<2.5	<0.05	1.3	18.0	NR	NR	0.26	0.054	0.013	<0.01	NR	0.015
m-Dichlorobenzene	0.85	8.4	5.9	0.49	1.3	11.0	2.4	NR	2.1	0.21	0.12	<0.02	NR	NR
o-, p-Dichlor-obenzene	<0.28	11.0	8.8	3.0	6.7	51.0	91.0	NR	9.3	1.2	0.48	<0.02	NR	NR

* Results are summarized here only for those samples in which at least one contaminant was detected at a concentration of 1 mg/kg or higher. Additional analytical data on soil borings are provided in reference 4.
** Laboratory estimate
NR = Not Reported

- During installation of soil borings in 1989, soil types were identified according to the Unified Soil Classification System. The soil types were identified for depths ranging from 5 to 50 feet bgs and are shown in Table ST-1. (4)

Table ST-1. Soil Types Identified for 1989 Soil Borings, According to the Unified Soil Classification System (4)

Depth (ft bgs)	Soil Boring No.				
	AP-2988	AP-2989	AP-2990	AP-2991	AP-2992
5	SP	-	GW	-	GW-GM
10	SP	GW	GW-GC	-	GW-GC
15	GP	-	GW	-	GW-GC
20	SP	GP-GC	GP-GC	GP-GC	GP-GC
25	-	GW-GC	GW	GP-GC	-
30	GW-GC	GW	GW	GP-GC	GW-GC
35	GW-GC	GP	GP-GC	-	GW-GC
40	GW	GP-GC	GW-GC	-	GP
45	GW-GC	GW	-	-	-
50	GP-GC	GW-GC	-	-	-

SP = Poorly graded sand with gravel and cobbles
GP = Poorly graded gravel with sand
GW = Well-graded gravel with sand
GP-GC = Poorly graded gravel with clay and sand
GW-GC = Well-graded gravel with clay and sand
GW-GM = Well-graded gravel with silt, sand, and cobbles

GEOLOGY (4):

- Ft. Richardson occupies lowlands to the west of the Chugach Mountains. The lowlands consist of surface deposits of glacial till, outwash, and silt. The Elmendorf Moraine transects the installation in a northeast-southwest direction and consists of glacial deposits of unconsolidated till composed of poorly sorted boulders, gravel, sand, and silt.

- A thin mantle of fine-grained soil, generally about two to five feet in thickness, blankets the area. Relatively clean, coarse-grained soils derived from outwash and glacial debris underlie the surface fines and extend to depths ranging approximately from 10 to 50 feet.

- Groundwater under Ft. Richardson occurs primarily as a result of percolation from surface water. At Building 908, the groundwater is present at depths greater than 50 ft bgs .

Treatment System Description

PRIMARY TREATMENT TECHNOLOGY TYPE (7)

SVE

SUPPLEMENTARY TREATMENT TECHNOLOGY TYPE

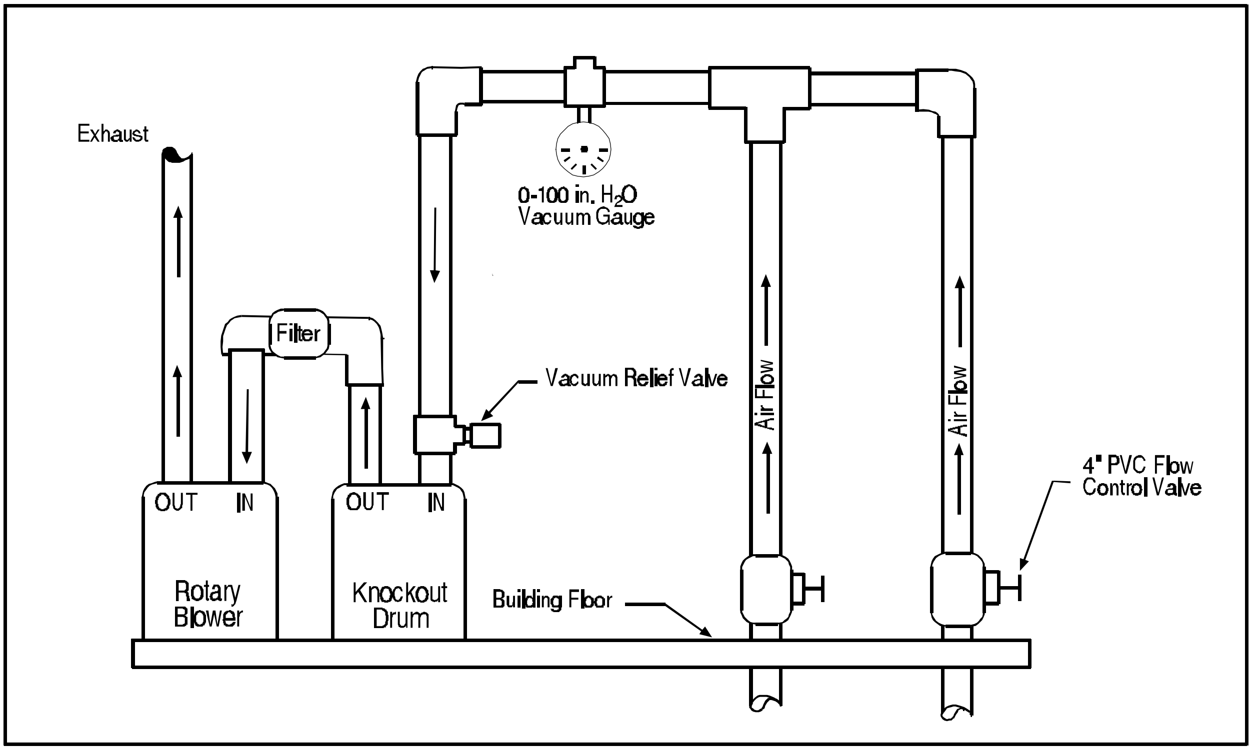
None

TIMELINE (4, 5, 6, 8)

Date	Activity
September 1989	1,000-gallon unregulated heating oil (Tank No. 82) was removed from an area adjacent to Building 908 South; with five soil borings collected during excavation
August - September 1990	Additional site characterization activities were conducted at Building 908 South
November 17, 1994	Construction began for SVE system
February 20, 1995	SVE treatment system began operation
March 1996	Interim soil boring collected
May 1996	Interim remedial action report was prepared
Spring 1999	Closure activities planned

TREATMENT SYSTEM SCHEMATIC AND TECHNOLOGY DESCRIPTION AND OPERATION

Figure 2. Process Schematic for Aboveground Equipment (6)



System Design and Construction (5, 6)

- The SVE system designed for Ft. Richardson consisted of two SVE wells (SVE-1 and SVE-2) and aboveground equipment that included a knockout drum, a particulate filter, and a rotary blower. Figure 1 shows the locations of the two extraction wells and shelter for the aboveground equipment. Figure 2 presents a process schematic for the aboveground equipment.

- The SVE wells were installed to a depth of 55 ft bgs, and were screened in the interval from 7 to 50 ft bgs. To accommodate the low temperatures expected for the application, heat trace (5 watts per ft) was installed in each well to a depth of 8 ft bgs. The references available provide no information about temperatures expected for the application.

- The wells were piped individually to the equipment shelter through horizontal trenches installed 30 inches bgs. Heat-traced, insulated arctic pipe was used in the trenches.

- The rotary blower used in the application was a EG&G Rotron EN-707 regenerative blower, a three-phase, five-horsepower blower with a maximum suction of 85 standard cubic feet per minute (scfm) at 87 inches of water.

Operation (5, 6, 8)

- The SVE system began operation on February 20, 1995 and is expected to operate through Spring 1999, when closure sampling will be conducted.

- The following system parameters were monitored during the application: extraction air flow rate, vacuum at wells SVE-1 and SVE-2, vacuum from each extraction line in the equipment shelter, change in pressure from inlet to outlet side of the filter (filter differential), change in pressure from inlet to outlet side of the blower (blower differential), total organic vapor concentration (measured with a photoionization detector (PID) from each extraction line in the equipment shelter, and total organic vapor concentration in the exhaust stack from the rotary blower. Table TSO-1 shows the results of monitoring of system parameters as of February 15, 1996.

- As Table TSO-1 shows, vacuums from wells SVE-1 and -2 measured at the shelter were as high as 37 inches water (Well SVE-1, January 16, 1996), and were generally higher than vacuums measured at the wells. Air flow rates and filter and blower differentials were relatively constant over the course of the monitoring period, while concentrations of volatile organic compounds decreased both at the shelter and in the blower exhaust.

- The references available provide no information about the percentage of time that the system was on line during the period from February 1995 to March 1996.

Initial Activities (5)

The remediation contractor performed the following activities for the application:

- Soil collected during installation of the extraction wells was used as source material for a nutrient and bacteriological evaluation and in a laboratory-scale test to determine optimal nutrient and thermal parameters for operation of the system.

- The need for passive or active air injection and the need for thermal enhancement (direct steam injection, steam recirculation, hot water recirculation, and buried electrical element (heat trace) heating systems) were evaluated.

- An assessment was made of the initial soil respiration rate and the soil permeability. For the respiration test, a very-low-volume air extraction blower was used to obtain representative samples of soil gas for analysis of oxygen, carbon dioxide, and extracted contaminants. For the permeability test, a higher-volume blower was used.

The references available provide no information about the results of the initial nutrient, bacteriological, air injection, thermal enhancement, soil respirometry, and soil permeability evaluations.

Table TSO-1. System Monitoring Results (6)

Date	Extraction Air Flow Rate (scfm)	Vacuum at Well SVE-1 (inches water)	Vacuum at Well SVE-2 (inches water)	Vacuum at Shelter from Well SVE-1 (inches water)	Vacuum at Shelter from Well SVE-2 (inches water)	Filter Differential (inches water)	Blower Differential (inches water)	Total Organic Vapor Conc. at Shelter from SVE-1 (ppm)	Total Organic Vapor Conc. at Shelter from SVE-2 (ppm)	Total Organic Vapor Conc. at Exhaust Stack/Blower (ppm)
2/20/95	210	6.6	3.2	NR	NR	22	33	10	100	29
3/1/95	205	6.4	3.6	8.7	8.7	22	34	2	39	20
4/18/95	205	NT	NT	9.0	9.0	23	34	NT	NT	1
5/16/95	205	6.0	3.2	34.0	34.0	24	34	3	NT	4
7/27/95	210	NT	NT	7.5	7.5	23	33	3	9	4
8/21/95	210	NT	NT	10.0	33.0	23	33	2	12	10
10/19/95	215	6.0	4.5	7.5	7.5	23	33	1	2	1
11/14/95	220	NT	NT	7.6	7.6	23	32	NT	NT	1
12/14/95	210	5.0	3.3	8.0	6.4	23	33	2	1	4
1/16/96	205	NT	NT	37	*	*	34	0.7	*	1.8
2/15/96	205	7.5	2	12	12	22	34	0.5	*	0

NR = Not reported
NT = Not taken
* = Water present in line

Closure and Site Restoration (1, 8)

- Closure and site restoration activities will be conducted after operation of the system has been completed (projected Spring 1999) and will include additional soil sampling.

OPERATING PARAMETERS AFFECTING TREATMENT COST OR PERFORMANCE

Listed below are the major operating parameters affecting cost or performance for this technology and the values measured for each parameter.

Parameter	Value
Air Flow Rate	205 - 220 scfm
Operating Pressure/Vacuum	2 - 7.5 inches water vacuum (at wells)
Operating Time	Information not available
Temperature	Information not available

TREATMENT SYSTEM PERFORMANCE

PERFORMANCE OBJECTIVES (4)

- ADEC Matrix Level B cleanup levels were identified for the application. Table CL-1 shows those levels.

Table CL-1. Cleanup Levels for Soil at Ft. Richardson Building 908 South (4)

Contaminant	Cleanup Level (mg/kg)
DRO	200
GRO	100
Benzene	0.5
Total BTEX	15

- Confirmation that cleanup levels have been met will be performed during close-out sampling.
- No performance objectives were established for air emissions from the blower for the application.

TREATMENT PERFORMANCE DATA (6)

- In March 1996, a soil boring, located within the area of contamination (Figure 1), was collected and analyzed for DRO by method AK 102, GRO by method AK 101, and benzene and total BTEX by method 8020. From March 1995 through February 1996, six samples from the exhaust stack from the blower were collected and analyzed for DRO by EPA Method 5030/8100 and GRO by EPA method 5030/8015. The results of analysis of the exhaust stack samples and soil boring are shown in Tables TPD-1 and TPD-2, respectively.

- In addition, samples were collected from the soil excavated during installation of wells SVE-1 and SVE-2. The samples were collected at depths of 25, 45, and 55 ft bgs and analyzed for DRO, GRO, benzene, and total BTEX. According to the remediation contractor, analysis of all samples showed that concentrations of those parameters were lower than their respective cleanup levels, with the exception of a soil sample taken from SVE-2 at 40 ft bgs, which showed DRO at 250 mg/kg. However, the results of those analyses were not included in the available references.

- According to USACE, the concentrations in the soil boring collected in March 1996 were assumed to represent the average concentrations of contaminants in the treated soil.

Table TPD-1. Results of Analysis of Sample from Blower Exhaust Stack (6)

Date	DRO (lbs/day)	GRO (lbs/day)
3/1/95	1.10	0.52
4/18/95	0.16	0.00
5/16/95	0.50	0.21
7/27/95	0.34	0.10
10/19/95	0.34	0.09
2/15/96	0.10	0.02

Table TPD-2. Results of Analysis of Soil Boring Collected March 1996 (6)

Depth (ft bgs)	DRO (mg/kg)	GRO (mg/kg)	Benzene (mg/kg)	Total BTEX (mg/kg)
Cleanup Level	**200**	**100**	**0.5**	**15**
25	53	20	ND	0.199
30	10	ND	ND	ND
30 (duplicate sample)	7	ND	ND	ND
35	ND	ND	ND	ND
40	ND	ND	ND	ND
45	15	ND	ND	ND
50	10	ND	ND	ND

PERFORMANCE DATA ASSESSMENT

- The analytical data presented in Table TPD-2 show that, as of March 1996, the concentrations of DRO, GRO, benzene, and total BTEX in the soil boring were lower than their respective cleanup goals at all soil depths sampled (25 to 50 ft bgs). The highest concentrations were found at 25 ft bgs, where DRO was measured at 53 mg/kg, GRO at 20 mg/kg, and total BTEX at 0.199 mg/kg.

- The analytical data shown in Table TPD-1 indicate that emissions of DRO from the blower were reduced by approximately 90 percent over a one-year operating period (from March 1995 to February 1996) and that emissions of GRO were reduced by approximately 95 percent over the same period.

Material Balance: Only a limited amount of analytical data were available for the application (for example, no data were available on quantity of contaminants in the soil before treatment or on the cumulative mass of contaminant removed); therefore no material balance was performed for this application.

PERFORMANCE DATA QUALITY (6)

- Available information related to the quality of treatment performance data includes names of analytical laboratories, analytical methods used, and results of quality control analyses.

- Samples of blower exhaust air were analyzed by Commercial Testing & Engineering Co. (CT&E). CT&E analyzed DRO by EPA Method 5030/8100 and GRO by EPA Method 5030/8015. National Institute for Occupational Safety and Health (NIOSH) Method 1501 was used to extract the samples.

- The soil boring samples were collected by a split-spoon sampler and analyzed by Superior Analytical Laboratory (Superior). Superior analyzed DRO by Method AK101, GRO by Method AK102, and BTEX by Method 8020.

- The remediation contractor noted no exceptions to quality assurance and quality control (QA/QC) procedures or protocols for the application. QA/QC procedures included use of duplicate soil samples, method blanks, equipment blanks, and trip blanks.

TREATMENT SYSTEM COST

PROCUREMENT PROCESS (2, 7)

- The references available provide only limited information about the procurement process.

- In September 1994, USACE prepared a detailed government estimate of costs for the application, using the MCASES Gold Edition software, release 5.30. The estimate was based on use of the hazardous, toxic, and radioactive waste (HTRW) work breakdown structure (WBS) for in situ biodegradation and bioreclamation. The government estimated that performance of the application would cost $354,608, a total consisting of $61,376 for preparation and submittal of the work plan, $220,943 for site work and the bioventing system, and $72,289 for site work and installation and operation of the nutrient addition system.

- The project was conducted as a delivery order under an IDTRA contract. USACE solicited proposals for the contract, and a prime contractor was selected on the basis of technical qualifications to perform a variety of remedial actions that might be necessary for the application. Prime contractors were required to prepare cost estimates when they were issued a delivery order; for work that was to be performed by a subcontractor, the prime contractor was required to obtain at least three bids from prospective subcontractors.

TREATMENT SYSTEM COST (1)

- Cost information was provided for award cost only:
  - The award cost for this application was $305,053, approximately 86 percent of the cost estimated by the government. The $305,053 consisted of approximately $52,800 for before-treatment activities (such as preparation and submittal of a work plan; completion of a biotreatability test; performance of in situ respirometry, air permeability, and groundwater sparging tests; system design; and site investigation); $190,000 for construction and operation of a bioventing system, and $62,200 for construction and operation of a nutrient addition system. (The costs of the bioventing and nutrient addition systems are assumed to be equal to the costs of an SVE system). The latter two costs (a total of $252,200) are the costs of activities directly attributed to treatment.
  - The $252,200 total for SVE was divided into costs for construction and operation. Construction costs were estimated at $116,900, with operation costs estimated at $135,300.
- The application at Ft. Richardson has not yet been completed; information about actual costs therefore was not available. It is not yet known how the actual costs will compare with award costs.

REGULATORY/INSTITUTIONAL ISSUES

- This application was a voluntary cleanup action that involved treatment of petroleum-contaminated soil near an unregulated heating oil tank. According to the contractor, the cleanup was conducted under the guidelines set forth in the ADEC Underground Storage Tank Regulations (18 AAC 78). The treated soil was required to meet ADEC Matrix Level B cleanup levels. (6, 7)

OBSERVATIONS AND LESSONS LEARNED

COST OBSERVATIONS AND LESSONS LEARNED

- The award cost for SVE at Ft. Richardson Building 908 South was $252,200 for activities directly attributed to treatment, representing a unit cost of $55 per cubic yard of soil treated (4,600 cubic yards treated). The available references contain insufficient information to calculate a unit cost per pound of contaminant extracted.

PERFORMANCE OBSERVATIONS AND LESSONS LEARNED

- The soil boring collected in March 1996 showed that after one year of operation all contaminants were measured at concentrations less than their respective cleanup levels (DRO - 200 mg/kg, GRO - 100 mg/kg, benzene 0.5 mg/kg, and total BTEX - 15 mg/kg).

- Data on the concentrations of the target contaminants in soil before cleanup operation began is limited; therefore, the percent reduction of these contaminants during treatment cannot be calculated. However, data collected during the 1989 site investigations showed concentrations of petroleum hydrocarbons in the soil as high as 17,000 mg/kg for diesel fuel #2 and 1,200 mg/kg for kerosene. In addition, VOCs were detected as high as 91 mg/kg for o-, p-dichlorobenzene and 70 mg/kg for m-xylene.

- According to a representative of USACE, the reductions in concentrations of contaminants at the site were greater than expected for a site contaminated with diesel fuel in gravelly soil mixed with clay. (7)

- The mass of DRO and GRO in the exhaust stack of the extraction system was reduced by greater than 90 percent during the period from March 1995 to February 1996.

- The system will be shut down if closure sampling planned for Spring 1999 confirms that contaminants in the entire area have been reduced to below cleanup levels. (8)

OTHER OBSERVATIONS AND LESSONS LEARNED

The remediation contractor provided the following additional observations and lessons learned:

- By February 1996, the bioventing system was approaching an asymptotic level of performance.

- The lateral extent of contamination could not be estimated accurately from the data available. The contractor recommended that three additional soil borings be installed and that each of the borings be sampled at five-foot intervals from 25 to 50 ft bgs and the samples analyzed for DRO, GRO, and BTEX. The references available do not indicate whether the borings were installed.

REFERENCES

1. USACE HTRW-CE. 1996. Cost Data for Innovative Treatment Technologies. November.

2. U.S. Army Corps of Engineers. 1994. Project FTR036: Bioventing POL. Soil Bldg 908 S - Fort Richardson, Alaska, Revised Government Estimate. September 12.

3. Miscellaneous Contractual Documentation, DACA85-94-C-0000, July 1994.

4. U.S. Army Corps of Engineers, Alaska District. 1994. Underground Storage Tank Remediation, Four Sites at Fort Richardson, Alaska; Site Assessment/Release Investigation Report and Corrective Action Report. Revised February 14.

5. AGRA Earth & Environmental. 1994. Fort Richardson Building 908 South Bioventing System Conceptual Design, Contract No. DACA 85-94-D-0014, Delivery Order #0003. October.

6. AGRA Earth & Environmental. 1996. Interim Remedial Action Report for Bioventing System at Building 908 South, Fort Richardson, Alaska. May.

7. B. Gagnon, USACE - Alaska District. 1997. Comments and Responses on Pre-draft Report. December 2.

8. Berman, Michael H. 1998. Record of Telephone Conversation with Bernard Gagnon. June 19.

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